Index No …….

1) (a) Write the SQL query to create the Employee table with the following constraints.

Employee (EmpId, Name, Address, Telephone, Age)

- EmpId is a number used as the primary key
- Name cannot be null
- Default Address to be 'Galle'
- Telephone specifies a unique number
- Age should be a number between 20-60

[6 marks]

ANSWER IN THIS BOX

```
CREATE TABLE Employee (
   EmpId int  Primary Key,
   Name  CHAR(20) NOT NULL,
   Address CHAR(25) DEFAULT 'Galle',
   Telephone INT UNIQUE,
   Age INT CHECK (Age BETWEEN 20 AND 60));
```

(b) Consider the following relational schema to answer the given question.

Employee (eno, ename, hiredate, salary, saldifference)

Write a trigger to calculate and update the saldifference filed (difference between the old and new salary) when the salary is updated.

[6 marks]

ANSWER IN THIS BOX

```
DELIMITER //
CREATE TRIGGER SalUpdate
AFTER UPDATE ON Employee
FOR EACH ROW
BEGIN
  DECLARE sal_dif INT;

  IF NEW.salary > OLD.salary THEN
    SET sal_dif = NEW.salary - OLD.salary;
  ELSE
    SET sal_dif = OLD.salary - NEW.salary;
  END IF;

  UPDATE Employee SET saldifference = sal_dif WHERE eno =
NEW.eno;
END//
```

```
DELIMITER ;
```

Suitable Answer

(c) Write down two (02) common uses of database triggers.

[4 marks]

ANSWER IN THIS BOX

-Provide sophisticated auditing
- Prevent invalid transactions
- Enforce referential integrity (either those actions not supported by declarative constraints or across nodes in a distributed database)
- Enforce complex business rules
- Enforce complex security authorizations
- Provide transparent event logging
- Automatically generate derived column values
- Enable building complex views that are updatable
- Track database events

Any two of the above.

(d) Suppose relation R1 (A,B) has tuples {(a,b), (a,b), (c,d)}, and relation R2 (B,C) has tuples {(b,e), (b,e), (d,f), (g,h)}. Consider the following SQL query.

```
SELECT * FROM R1 RIGHT OUTER JOIN R2 ON R1.B = R2.B;
```

What is the number of tuples in the result of the above SQL query?

.

[4 marks]

ANSWER IN THIS BOX

6 tuples

(e) Consider the relations Employee and Evaluation as given below to keep track of employees, and their job evaluation records.

Employee (Empid, First_name, Job_id, Salary, Department_id)
Evaluation (Empid, Evaluation_date , Job_id, Department_id, Score)

Write down a trigger named ***Salary_Increment*** to increase salary of an employee as given below (based on the Score value) upon insertion of his/her evaluation record into the Evaluation table.

- 25% salary increment if score is >= 9
- 15% salary increment if score >= 7 and score < 9

[5 marks]

ANSWER IN THIS BOX

```
DELIMITER $$

CREATE TRIGGER Salary_Increment
AFTER INSERT ON Evaluation
FOR EACH ROW
BEGIN
   IF (NEW.Score  >= 9) THEN
      UPDATE Employee
      SET Salary = Salary * 1.25
      WHERE Empid = NEW.Empid;
   ELSEIF (NEW.Score  >= 7 AND NEW.Score < 9) THEN
      UPDATE Employee
      SET Salary = Salary * 1.15
      WHERE Empid = NEW.Empid;
   END IF;
END$$

DELIMITER ;
```

Suitable answer

2) (a) Suppose that we have an ordered file with r = 30,000 records stored in a disk with block size B = 1024 bytes. File records are of fixed size and unspanned, with record size R = 50 bytes.

(i) Calculate the blocking factor (BFR).

[2 marks]

ANSWER IN THIS BOX

BFR = $\lfloor(1024/50)\rfloor$
= 20 records per block.

(ii) How many block accesses are required to search a record in the data file using the binary search?

[2 marks]

ANSWER IN THIS BOX

The number of blocks needed for the file is b = $\lceil(r/bfr)\rceil$
= $\lceil(30,000/20)\rceil$= 1500 blocks.
A binary search on the data file would need approximately $\lceil\log_2 b\rceil$

$= \lceil(\log_2 1500)\rceil = 11$ block accesses.

(iii) Suppose that the ordering key field of the file is V = 9 bytes long, a block pointer is P = 6 bytes long, and we have constructed a primary index for the file. How many block accesses are required to search a record using the primary index?

[4 marks]

ANSWER IN THIS BOX

Size of index entry is 9+6 = 15 bytes.
Blocking factor for index = $\lfloor(1024/15)\rfloor = 68$
Number of index entries is 1500
The number of index blocks is = $\lceil(1500/68)\rceil = 23$
To perform a binary search on index file would need $\lceil(\log_2 b_i)\rceil = \lceil(\log_2 23)\rceil = 5$ block accesses.
Total number of block access = 5 + 1 block accesses = 6 block accesses

(b) ***"Certain indexes may cause excessive overhead on the Database Management System and may cause to low performance".*** Is this statement correct or incorrect? Justify your answer.

[4 marks]

ANSWER IN THIS BOX

Correct

Every insert, update, or delete operation on the table also requires corresponding updates to the indexes, leading to slower write performance.

Creating too many or poorly chosen indexes (e.g., on columns rarely queried or updated frequently) leads to inefficient query plans and can even slow down query execution.

(c) Write down the difference between the **Dense Index** and the **Sparse Index**.

[4 marks]

ANSWER IN THIS BOX

Dense Index - Dense index contains an index record for every search key value in the

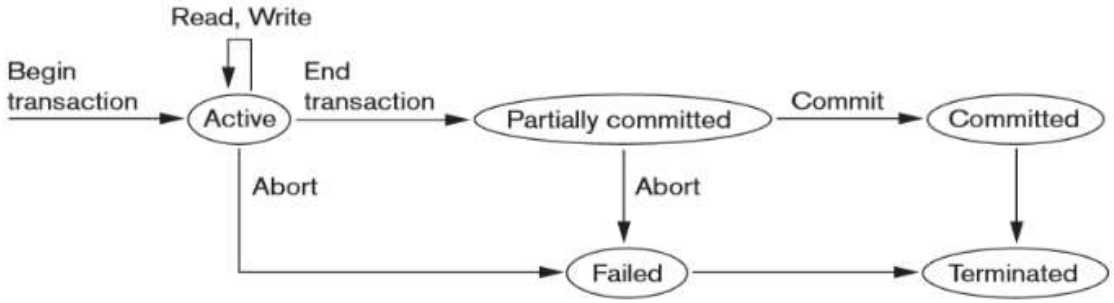
data file.

Sparse Index - Instead of pointing to each record in the main table, the index points to the records in the main table in a gap (index item points to a block).

(d) Illustrate the flow of transaction states using a diagram.

[6 marks]

ANSWER IN THIS BOX



Suitable diagram

(e) Briefly explain the **Lost Update problem** that can occur due to the concurrent execution of transactions using a suitable example.

[3 marks]

ANSWER IN THIS BOX

Lost Update problem

Occurs when two different transactions are trying to update the same column on the same row within a database at the same time.

T1	T2
READ(X) X = X – N	
	READ (X) X = X + M
WRITE(X) READ(Y)	
	WRITE(X)

Suitable example

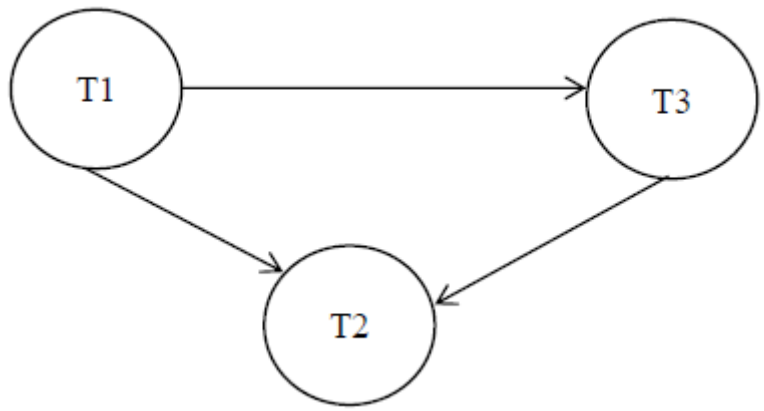
3) (a) Consider the following schedule S, consisting of three transactions T1, T2, and T3. Note that each R and W denotes read, and write operations respectively.

T1	T2	T3
W(A)		
	R(A)	
W(B)		
		W(B)
		W(B)
	W(A)	
		R(B)
	R(B)	

(i) Draw the precedence graph for S.

[5 marks]

ANSWER IN THIS BOX



(ii) Is S conflict serializable? Justify your answer.

[3 marks]

ANSWER IN THIS BOX

Yes. Because the graph did not contain cycles.
T1 → T3 → T2

(iii) Is S view serializable? Justify your answer.

[3 marks]

ANSWER IN THIS BOX

Yes. Since this is conflict serializable, this should be view serializable.
All the conflict serializable schedules are view serializable too.

(b) Consider the following T1 and T2 transactions. Note that each Lock-s and Lock-x denotes shared lock and exclusive lock respectively.

T1
Lock-s(A)
Read(A)
Lock-x(B)
Unlock(A)
Read(B)
Write(B)
Commit
Unlock(B)

T2
Lock-s(A)
Lock-x(B)
Read(B)
Write(B)
Read(A)
Unlock(A)
Commit
Unlock(B)

(i) What is the concurrency control protocols used in transaction T1?

[3 marks]

ANSWER IN THIS BOX

Strict 2PL

(ii) What is the concurrency control protocols used in transaction T2?

[3 marks]

ANSWER IN THIS BOX

Conservative 2PL / Static 2PL

(c) Write two (02) limitations in the ***Two Phase Locking*** protocol.

[4 marks]

ANSWER IN THIS BOX

Does not permit all possible serializable schedules
Cascading Rollback
Deadlocks

(d) Briefly explain the ***Wound-Wait*** deadlock prevention protocol**.**

[4 marks]

ANSWER IN THIS BOX

Younger transaction is allowed to wait on an older transaction,

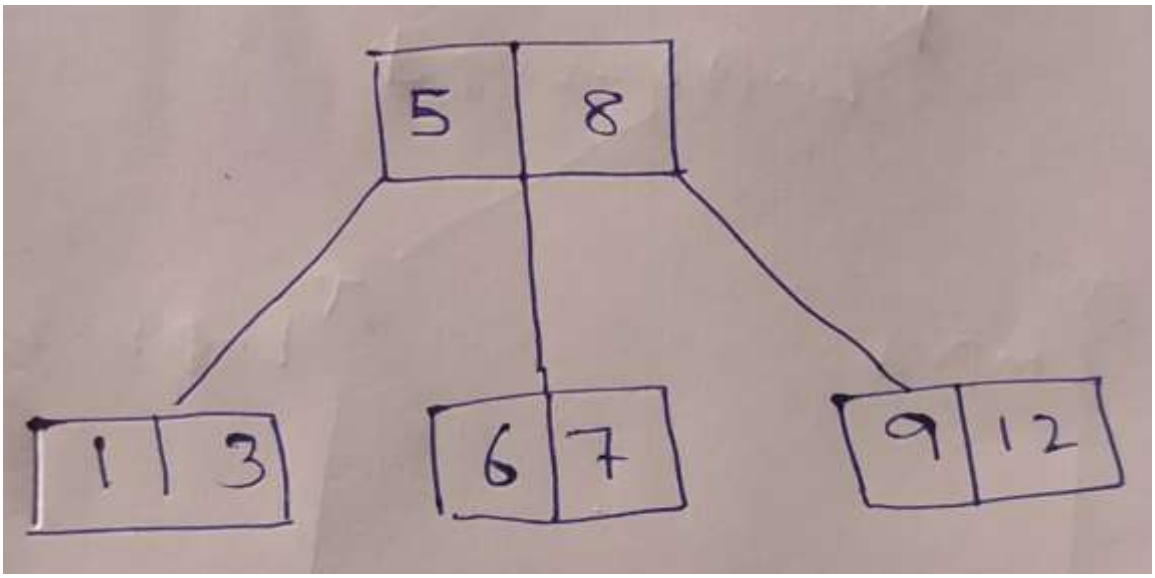
Older transaction requesting an item held by a younger transaction preempts the younger transaction by aborting it.

4 (a) Construct a B-tree of order three by inserting the following eight key values sequentially. Draw the final B-tree after all insertions are complete.

Key values: 8, 5, 1, 7, 3, 12, 9, 6

[5 marks]

ANSWER IN THIS BOX



(b) State two (02) disadvantages of distributed databases.

[4 marks]

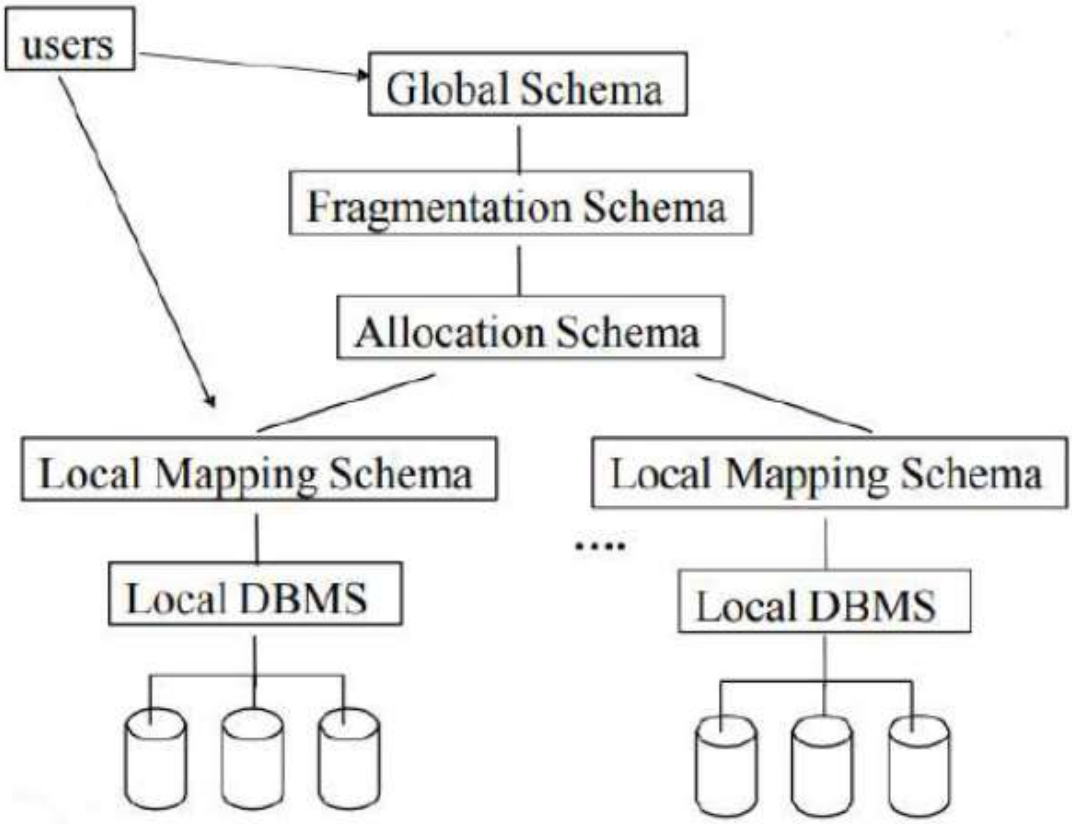
ANSWER IN THIS BOX

Complexity
Economics
Security
Difficult to maintain the integrity
Inexperience

(c) Draw the architectural diagram for a distributed database management system and identify its components.

[7 marks]

ANSWER IN THIS BOX



(d) Consider the following relational schema.

Employee (<u>EmpId</u>, Fname, Lname, Address, Gender, Salary, Bdate)
Project (<u>Pnumber</u>, Pname, location)
Works_on (<u>Pno</u>, <u>Empid</u>,)

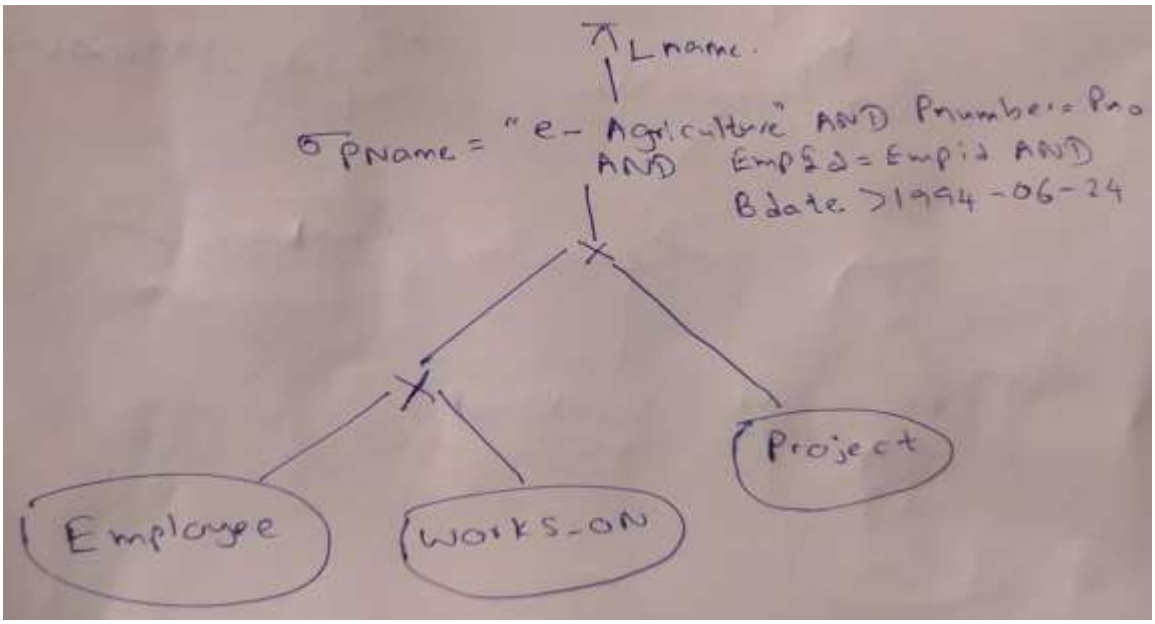
Consider the following SQL query.

```
Select E.Lname
From Employee E, Works_on W, Project P
Where P.Pname = 'e-Agriculture' And
P.Pnmuber= W.Pno And E.EmpId=W.Empid
And E.Bdate > '1994-06-24';
```

(i) Draw the initial query tree for the SQL query given above.

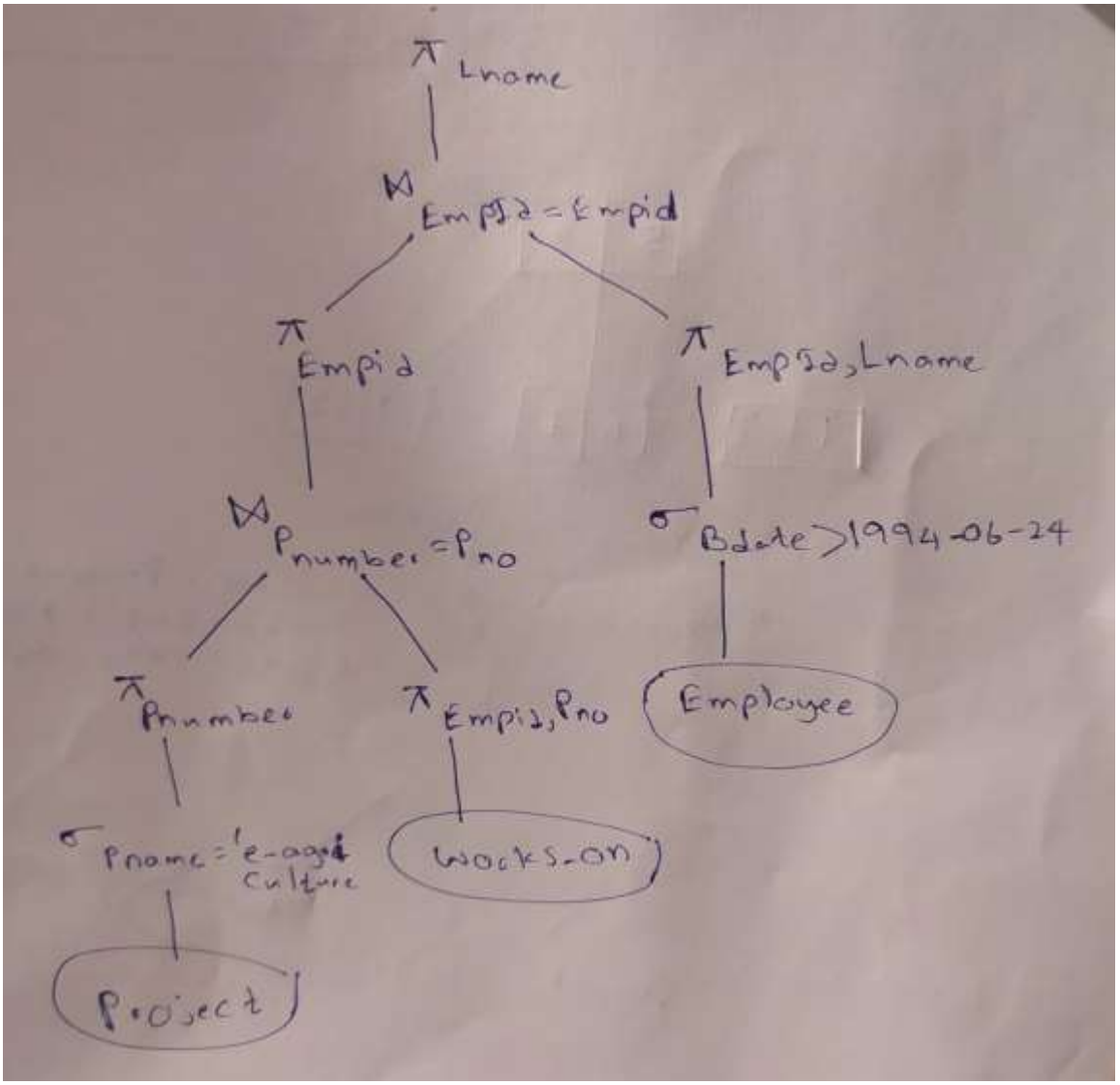
[4 marks]

ANSWER IN THIS BOX



(ii) Draw the optimized query tree for the SQL query given above.

[5 Marks]



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